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BUSINESS INTELLIGENCE AND PREDICTIVE ANALYTICS FOR FINANCIAL SERVICES: THE UNTAPPED POTENTIAL OF SOFT INFORMATION

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THE RISKY BUSINESS OF FINANCIAL LENDING

Credit risk analysis as well as credit risk management are fundamental to banks and financial institutions that provide loans (including credit cards, home equity loans, auto-loans, etc.) to retail and small business customers. Deciding who to give these loans to, the rate of interest at which these loans should be provided, as well as predicting the likelihood of default lie at the heart of credit risk analysis and management. Answers to these questions determine the profitability and even the survival of many a bank and financial institution. To enable answer these questions, banks and financial institutions collect vast amounts of information about their borrowers.

Predictive analytic techniques, credit scoring models, lending portfolio analyses, and other sophisticated statistical models are often employed by banks and lending institutions to understand and manage the risk of their loans and lending portfolios. While a large number of models and statistical techniques have been proposed, each lender uses their own proprietary credit scoring and risk analysis models based on a combination of public as well as private data about their borrowers. Although these proprietary models differ in a number of intricate ways, a characteristic common most predictive models, is that they rely primarily on “hard” information about borrowers.

Banks and financial institutions collect data on a large number of variables of interest. Primary among these “hard” credit variables is the credit score (e.g., FICO score). Personal credit scores provide a summary of the borrower’s financial history and are usually available from credit bureaus and rating agencies. Debt-to-income ratios, bank card utilization, number of previous credit inquiries, and time since the first credit line, are some of the other “hard” credit variables that are available to lenders. In addition, banks and financial institutions gather information relating to hundreds of variables such as,

- Demographics (Age, Gender, Education, Location, etc.)
- Family Details (Family Size, Number of Dependents, Age of dependents, etc.)
- Employment Details (Employer, Years in employment, etc.)
- Financial Details (Income, Networth, Assets, Financial statements, House Ownership, etc.)
- Property Details (Property Type, location, condition, value, etc.)
- Source of lead (Brokers, Direct, Existing customer, etc.)

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- Legal Factors (Bankruptcy laws, Tax laws, etc.)
- Market Conditions (Interest rates, Exchange rates, Housing Demand, Unemployment, etc.)

Information on these numerical or categorical variables form the mainstay of the predictive analytical models used by banks and lending institutions. Predictive models that are developed based on historical data on loans and performance measures, use the hard information about specific customers to determine the creditworthiness of the applicant, their likelihood of default or late-payments, the loan amount, the term of the loan, the type of loan or mortgage, as well as the pricing of the loan (interest rate, front-end type, back-end type, etc.). It is important to note that banks also attempt to collect private information about their applicants through interviews and questionnaires – information that is used to create an “internal score” for each borrower. However, for the most part, credit scoring and risk analysis models largely depend on hard information captured in the variables mentioned above.

Credit card issuers typically rely on “hard” information. Since they have millions of accounts to manage, credit-card issuers use automated decision rules. Among the different variables, the issuers rely heavily on credit-risk scores. While credit scores are publicly available from different credit bureaus, credit card issuers also use private information about the historical performance of the accounts. Automated decisions rules use a combination of public and private information to predict default, attrition, and utilization rates, among others.

Hard information, by nature, is quantifiable and is also easier to collect, store, process, and transmit. Most importantly, it is easier to automate the collection, processing, and transmission of hard information. Advances in information technologies over the decades have substantially reduced the cost of processing and transmitting hard information. The economies of scale in handling hard information have also given rise to the number of third-party firms whose primary task is to collect and disseminate hard information to banks and lending institutions. It is not surprising then, that banks, financial institutions, insurance companies, and credit card issuers, among others, have largely relied on hard information to guide their decision making.

THE VALUE OF HARD INFORMATION

Hard information about borrowers and applicants has been used extensively to develop, test, and refine analytical models that enable lenders to predict the behavior (abilities and intentions) of borrowers. Research studies on the role of hard information in managing credit risk for a wide variety of financial products provides strong evidence on the value of such information.

DEMOGRAPHIC VARIABLES

Variables such as race, gender, age, education, and income have known to be reliable indicators of a consumer's propensity to purchase (including financial products and services).

In the choice between home equity loans and credit lines, older consumers were found to be more likely to apply for a credit line than younger consumers. Further, more wealthy consumers, those with higher incomes, were found to be more likely to apply for a home equity credit line as compared to a home equity loan.

Demographics variables are also commonly used predictors of outcomes such as the interest rates, the performance of the loan, or the likelihood of default.

- In a study of over 170,000 credit card holders over a 2-year period, Agarwal et al () find that the youngest (30 years or younger) and the older (60 years or older) groups of consumers had the lowest bankruptcy risk. Homeownership was also found to lower bankruptcy rates.
- In a study of vehicle loans, Kofi et al (2008) find that racial minorities receive differential treatment from vehicle finance companies and pay higher interest rates (100 basis points more) on their new car loans.
- Agarwal et al () also find that an individual who is married is 24% less likely to default on his credit card debt and 32% less likely to file for bankruptcy.

PSYCHOGRAPHIC VARIABLES

Factors such as a consumer's "risk propensity" and "outlook" have also been shown to be predictive of consumers' choices. For instance, conservative risk-averse consumers were more likely to choose fixed rate home equity loans over credit lines, while consumers who anticipated future credit shocks preferred home equity credit lines over loans.

- Agarwal et al (2006) analyze data on 135,000 U.S. homeowners with home equity loans and home equity credit lines from multiple financial institutions to examine the impact of selected hard information variables on prepayment, likelihood of termination, and default rates.

BORROWER'S CREDIT SCORE

A borrower's credit score is considered the primary indicator of this creditworthiness. In a study of the impact of a borrower's credit score on outcomes, Agarwal et al (2006) find that:

- A 5% drop in borrower credit quality (as measured by their FICO score) decreases the likelihood of a homeowner prepaying a home equity loan by 7.5% and prepaying a home equity credit line by 3%.
- A 5% drop in borrower credit quality increases the probability of default for home loans by 17.2% and for home equity credit lines by 7.2%.

- In a related study, Lai et al (2005) find that the loan-to-value ratio, an important factor in primary mortgage prepayment, has little effect on the prepayment of home equity loans.
- Borrowers with higher risks were also found to self-select contracts requiring lower collateral levels and higher interest rates.
- In their study of credit card holders, Agarwal et al (2006), find that borrowers with lower FICO scores were more likely to default on their credit debt and file for bankruptcy. A 10-point drop in FICO score leads to a 4% increase in the likelihood of default and bankruptcy. Further, the same 10-point drop in FICO score for a less creditworthy borrower (with FICO < 620) led to a much higher risk of bankruptcy.

FINANCIAL FACTORS

After a borrower's credit score, his financial standing is often considered to be the most important indicator of his creditworthiness. In examining the role of *financial variables*, researchers find that:

- A borrower choosing to pledge less than 10% of collateral is 5.6% more likely to default in comparison to a borrower choosing to pledge more than 20% collateral.
- A lender's counteroffer with lower APR reduces default risk by 12%, while a counteroffer with higher APR increases default by 4%.
- Lower APR requirements also increase the odds of prepayment of home loans by 11%.
- Credit card holders with higher income were 17% less likely and those with higher wealth were 22% less likely to default on their credit card debt.
- As with home loans, an increase in APR (from 15% to 25%) increased the risk of bankruptcy by 7 basis points.
- An increase in debt from \$1000 to \$5000 increased the risk of bankruptcy by 32 basis points.

ECONOMIC VARIABLES

Macro-economic variables are used extensively as inputs in risk-scoring models and predictive models. As with the above mentioned hard variables, researchers have found that:

- A 1% point drop in mortgage interest rates increases the prepayment rate of home equity loans by 17.3%. However, a 1% point drop in mortgage interest rates increases the prepayment of home equity credit lines by only 9.6%.
- A 10% increase in home prices raises the prepayment rate of loans by 4.8% and prepayment of credit lines by 16.4%.

- Depreciation in the value of homes reduced the likelihood of consumers refinancing their mortgages.
- A 1% increase in the local unemployment rate increases prepayment of home equity loans by 5.8%, but reduces the prepayment of credit lines by 2.2%.
- Lai et al (2005) find that the prepayment of home equity loans is sensitive to changes in market interest rates. Borrowers are more likely to refinance their loans when market interest rates are lower than coupon interest rates.
- As with home equity loans, macro-economic variables also have a significant effect on credit card loans. A one standard deviation increase in unemployment increases default rate by 3%, while a similar decrease in house price growth rates increases default by 8%.

Similar effects of these traditional “hard” variables have also been found in studies of small business loans. Firm-specific attributes including the firm’s monthly net-income, the entrepreneur’s creditworthiness, the existence of collateral, the interest rate, the amount of the loan, local economic factors and market conditions have all been found to have a significant impact on the credit delinquencies and default rates.

As mentioned earlier, most banks and lending institutions gather data on several of the above-mentioned hard variables and incorporate them in to their predictive and risk analysis. While some of these hard credit risk variables have been well documented and form an integral part of most lending decisions, there exist huge disparities among lenders when it comes to the sophistication of the predictive models, as well as in how these hard variables are used in decision making.

The rapid emergence of new technologies has transformed several sectors. Sectors such as financial services and insurance are ideally suited for such transformation as they are not only information intensive but are also heavy users of computing and information technologies. While banks and financial institutions have used information technologies for creating sophisticated financial instruments and trading models, the current generation of computer and communication technologies has led to an explosion of non-traditional and novel types of information about consumers. In addition to the traditional hard variables discussed above, banks and lending institutions can now gather, store, and process soft (as well as, not-so-hard) information about consumers – information that can open new avenues for managing credit risk as well as for delivering better value to consumers. While some of this information comes from new sources that were not prevalent earlier, others come from existing sources whose potential is yet to be fully exploited.

HARD VERSUS SOFT INFORMATION

Hard information consists of information that can be quantified and easily transmitted across individuals and firms. Soft information, on the other hand, is not easily quantifiable or easily transmitted across individuals or organizations. Further, hard information is usually explicit, while soft information is often

tacit and might be embedded in the context. Another characteristic of hard information is precision. Soft information on the other hand, is usually imprecise, fuzzy and noisy.

According to Petersen (2002), hard information is numerical, it is gathered in an impersonal way, and is valued the same by different people. For instance, in a credit card or home loan approval decision, in addition to information on credit scores, income, networth, debt-to-income ratio, LTV, etc., the loan office might interview the applicant and have conversation with him. While variables such as income, networth, and debt-to-income ratios are clearly quantitative variables, information from the interviews and conversations with the applicant is typically considered soft information. It is not easily quantified and requires subjective evaluation of the loan officer. Despite the lack of “hardness”, few would doubt the value of gathering such soft information, or its importance in decision making.

Information relating to the value of the property or the loan-to-value has some characteristics of both hard and soft information as they are based on a subjective evaluation of the property as well. Thus, different types of information may exhibit different “degrees of hardness”. In other words, information can lie along a “spectrum of hardness” – from the very hard and tangible (e.g., accounting information) to the very soft and intangible (e.g., perceptions, speculation, gossip, and hearsay).

Hard and soft information may also differ along other dimensions. For instance, they may differ in *structure* (structured versus unstructured), *content* (facts versus perceptions); and *mode of expression* (numerical versus natural language).

THE UNTAPPED POTENTIAL OF SOFT (AND NOT-SO-SOFT) INFORMATION

THE NOT-SO-SOFT INFORMATION

EXISTING RELATIONSHIPS

Several banks and financial institutions provide a plethora of financial (as well as insurance) products and services, and serve as one-stop shop for customers. Given the one-stop shopping format, financial services firms seek to cross-sell their products and services to customers. Despite, the availability of information about their existing customers, few firms actively leverage this information to better design their product and service offerings.

Existing relationships can be classified along the following dimensions.

- *Breadth of relationship* (i.e., number of relationships with the financial institution)
- *Length of relationship* (duration of each relationship)
- *Type of relationships* (deposits, investments, loans, etc..)
- *Depth of relationships* (\$ amount of balances, deposits, etc.,..)

Research indicates that gathering, quantifying, and processing the information on these relationships can be very useful for lending decisions. In a study of relationship banking, using data on over 100,000 credit card accounts, Agarwal et al (2009), find a significant impact of the different dimensions of existing relationships on various outcomes of interest to lending institutions.

- Credit card accounts with at least one another relationship with the bank have 10% lower default rates, 12% lower attrition rates, and 7% higher utilization rates, compared to those without relationships.
- The likelihood of default decreases by 2% for the 1st and by up to 18% for the 6th relationship.
- The likelihood of default decreases by 14% for existing investment relationships, 8% for existing deposit relationships, and 4% for existing loan relationships.
- The likelihood of default decreases by up to 13%, for each standard deviation increase in the age of existing relationships.
- The likelihood of default decrease by up to 20% for increase in asset balances. Volatile asset balances are associated with higher default rates.

While applicants with existing relationships are generally perceived to be less risky, and receive more favorable terms (higher credit limits and lower APRs), the effects of the different dimensions of these relationships are typically not quantified, as is the case with other hard-credit variables.

SOURCE OF LEADS

Banks acquire their customers through a number of different sources – brokers, agents, walk-ins, among others. Customers who apply for a loan through a broker might systematically differ on a number of characteristics – the analyses of which might provide valuable insights to the lenders. Prior studies (Jiang et al, 2009) of customers acquired through different sources highlight interesting differences.

- Brokers were more likely to provide banks with borrowers of lower average quality than borrowers who applied for a loan with the bank directly.
- Home equity loans originated through a mortgage broker were 10 – 14 percentage points more likely to become delinquent compared to loans acquired directly by the bank.
- Home equity loans that had less documentation had a 5 – 8 percent points higher probability of delinquency compared to those with complete documentation.

As earlier, while banks and lending institutions have access to information about the source of their leads and use them in pricing the loans, such information also needs to be incorporated into models that predict default and performance of the loans.

CHANNEL/TECHNOLOGY CHOICE AND USAGE

Banks today use a number of different channels to reach potential customers and usually offer their potential customers and borrowers multiple channels and mechanisms to choose from. Starting with the choice of different channels to solicit customers, to providing customers different channels to conduct transactions with the bank, the availability of choices has grown considerably in recent times. Interestingly, customers typically self-select into different channels for reasons such as convenience, ease of use, timeliness, etc. Research studies have examined how such choices correlate with various outcomes of interest to the banks.

- In a study of different solicitation mechanisms used by banks, Agarwal and Ambrose (2009) find that walk-in customers were more likely to choose Adjustable-Rate Mortgages during periods of higher interest rates. Interestingly, customers who received Direct Mail solicitations were more likely to ignore important economic and environmental conditions.
- Financially sophisticated consumers (higher incomes and higher credit scores) were also more likely to switch away from the offer (in the direct mail) to a different product. Also, older consumers were less likely to switch compared to younger consumers. For example, they find that a 56-year old consumer is 33% less likely to switch compared to a 46-year old consumer.
- In a study of online versus offline (in-person) applicants for small-business loans, they find that online borrowers were 5% more likely to decline loan offers and seek credit elsewhere.
- While 69% of the rejected online applicants managed to obtain a loan from another source within a month, only 30% of the rejected in-person applicants managed to obtain a loan from another source.
- Online applicants had a 3.2% default rate compared to 2.7% for in-person applicants.
- In another study, Agarwal et al (2007) find that borrowers who automatically paid their monthly mortgages directly from their checking account were 4.2% less likely to default, relative to borrowers who paid by invoice.

SOFT INFORMATION

SOCIAL CAPITAL

Social capital refers to social networks, norms, and trust created by human interactions in communities. Individuals make independent decisions about whether, and how much, to invest in “social capital” – decisions, which when aggregated can have significant impact on economic outcomes.

In a typical microfinancing context, a borrower’s community and social contacts

- In a study of the role of a borrower’s community in microfinancing, Karlan et al (2009) find that social connections are highly valuable – a borrower’s friend serves the role of monitoring and

enforcement, and having a friend cosigner is equivalent to 18% of the face value of a 6-month loan.

- When repayments (of a borrower) are cosigned by direct friends (with the cosigner being fully responsible for the loan) as compared to strangers, the repayment rates increase by about 20%.

These findings suggest that a borrower's community and social capital can serve as informal, yet effective, enforcement mechanisms, particularly when it comes to repayments from lower quality borrowers.

TRUST

Trust is central to financial transactions. Lack of trust causes "frictions" in transactions, and gives rise to the need for mechanisms such as contracts, collateral, and additional enforcements, that make market transactions feasible. Mechanisms that induce trust, on the other hand, can reduce the need for additional enforcements and monitoring to manage risk, and even improve the efficiency of transactions.

- Social networks play an important role in building trust. Karlan et al (2008) find that social networks create trust when agents use their connections as social collateral to facilitate informal borrowing.
- Open networks (i.e. networks with low closure) can provide access to diverse resources (information and capital), while networks with high closure can facilitate the enforcement of cooperation and trust, lowering the risk of financial transactions.
- Networks with higher closure would facilitate higher value transactions due to increased trust from the dense connections and repeated interactions.

SOCIAL COMMUNITIES AND MOBILITY

Investment in social capital happens over time and the returns to this investment depreciate when one moves out of the community. Mobility thus, not only reduces the individual's investment in their social capital, but also any reputational concerns that arise from close ties to the community.

- Agarwal et al find that risk of personal bankruptcy and default is higher for an individual who migrates out of his state of birth. Individuals who live in their state of birth are 9% less likely to default on credit card debt, and 13% less likely to file for bankruptcy.
- An individual who moves 190 miles from his birthplace is 17% more likely to default and 15% more likely to declare bankruptcy.
- Individuals who move to a rural area are 9% less likely to default and 7% less likely to declare bankruptcy.

THE ROLE OF SOCIAL NETWORKS IN FINANCIAL LENDING

Several studies have highlighted the value of an individual's social network on various transactional outcomes in a number of contexts. Lin et al (2009) study transactions between individual lenders and borrowers in a decentralized online peer-to-peer lending market to answer the following questions.

- Does a borrower's social network provide information about his credit-worthiness and default rates?
- Can a borrower's likelihood of default be predicted from the default rates in his network?

Web 2.0 technologies have given rise to a number of new business models and transformed a wide variety of sectors. One of the latest such business models is the decentralized online peer-to-peer lending marketplace, in which individual lenders submit bids to lend to individual borrowers seeking microloans, without the intervention of a bank or any centralized financial intermediary. A few interesting technological features differentiate this decentralized online lending market from traditional lending contexts. First, it uses an auction mechanism – lenders bid to lend small amount to borrowers seeking loans, with the average bid size being just \$60. Bids from several lenders are aggregated to create the loan requested by the borrower. Secondly, borrowers can create their online social networks by inviting their friends to be part of this marketplace; each borrower's social network and the actions of their friends being visible to all potential lenders.

Analyzing over 200,000 loan requests by borrowers over a 18-month period, Lin et al (2009) find that all hard credit variables have significant effects as expected on the three outcomes of interest – the probability of a borrower obtaining a loan, the interest rate of funded loans, and the likelihood of default.

In examining the role of soft information contained in a borrower's social network, they find that a borrower who had more friends has better outcomes – a higher probability of funding, a lower interest rate, as well as a lower probability of default. Interestingly, borrowers whose friends remain passive (i.e., they do not themselves lend money to the borrower, or even bid on her listing) experience negative outcomes. However, visible and verifiable actions from friends (such as bidding on the borrower's listing, or submitting a winning bid and lending money to the borrower friend) lead to significantly positive outcomes for borrowers.

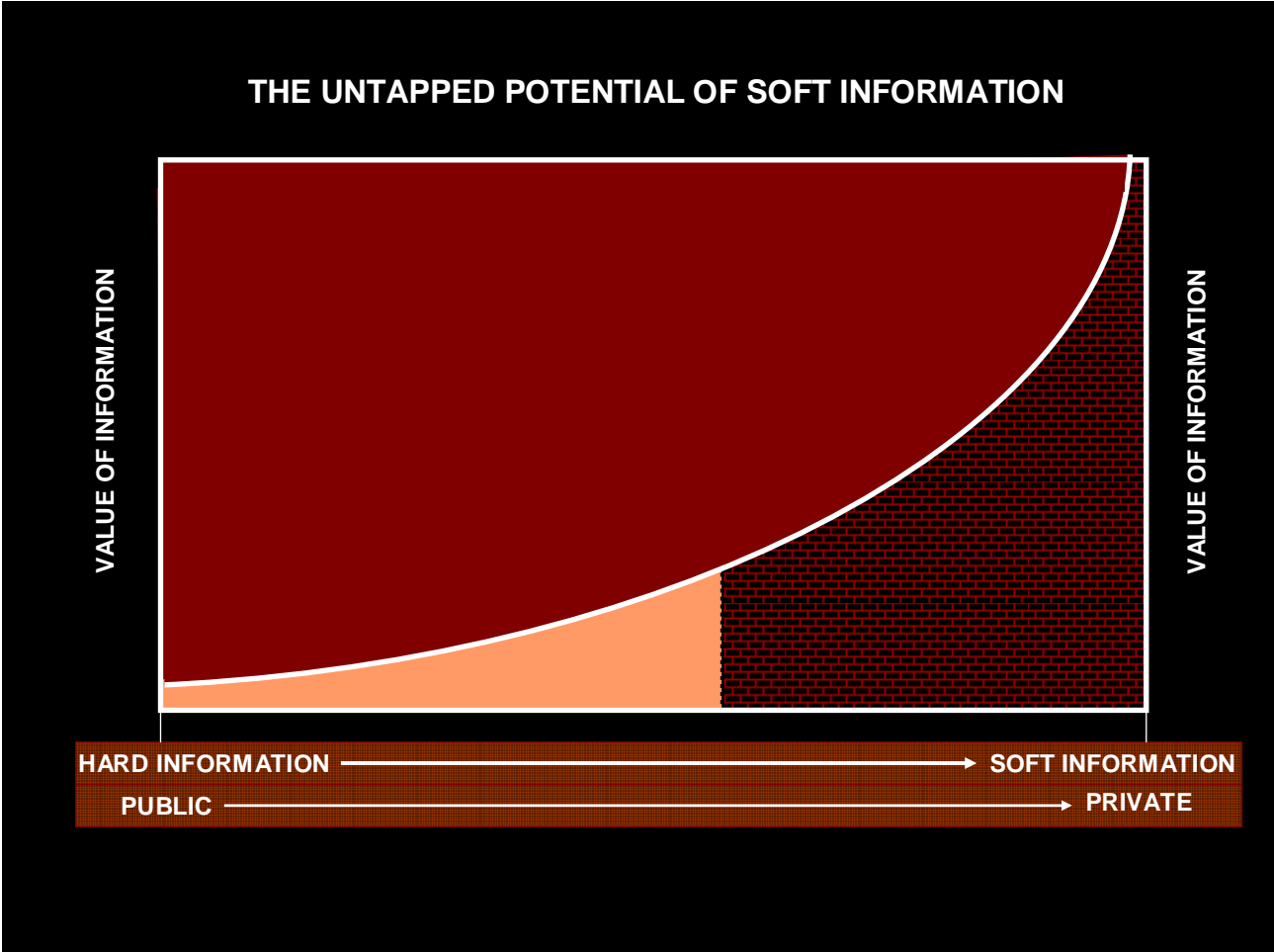
The study also examines the mechanism by which social networks lead to positive outcomes. They find that rather than acting as "pipes" (i.e. conduits for resources - money or information), a borrower's social network acts as a "prism", where the actions of the borrower's friends signal the creditworthiness of the borrower to other potential lenders.

The study also finds evidence for "contagion" in these social networks. Just as viruses are contagious (spreading through a network of contacts), they find that default is also "contagious". In other words, the defaults in a borrower's social network are highly predictive of the borrower's own default! Something to think about!

Mingfeng Lin, N.R. Prabhala, and Viswanathan, S. "*Judging Borrowers By the Company They Keep: Social Networks and Adverse Selection in Online Peer-to-Peer Lending*". Available on SSRN [<http://ssrn.com/abstract=1355679>]

While there has clearly been a growing recognition of the importance of soft information in the retail banking and lending sectors, the role of soft information in driving lending decisions is still in its infancy.

Evidence suggests that soft information can add a lot of value to banks and financial institutions by supplying the missing pieces that complement existing hard information used by banks to make lending decisions. While there is no doubt that hard information is very valuable to lending decisions as is evident from practice, most of the hard information about applicants and borrowers is “public” by nature, in that, information on these variables are available (albeit, at a cost) to all competing banks and lenders. This “public” nature of hard information also reduces the value that any one lender can appropriate as any gains from identifying good borrowers are quickly competed away. Thus, while it is easier and cheaper to gather and process for hard information, so is it for competitors.



On the other hand, as indicated by the figure above, the value contained in soft information could be exponentially higher, since the behavior of borrowers is not easily captured by just hard numbers. A variety of soft factors determine outcomes, and understanding the information contained in these soft

factors can provide crucial insights into the behavior of borrowers, substantially improving the bank's ability to predict and manage risk.

In addition, soft factors can be very context dependent and by their very nature difficult to quantify and transmit. This "private" nature of soft information can also make it difficult for competitors to appropriate the benefits of an individual lender's ability to gather and process such information. In other words, the value from soft information is less likely to be competed away, as is the case with hard information.

THE HARDENING OF SOFT INFORMATION

Traditional predictive analytical and credit risk models have largely been constrained by the lack of availability of soft information about customers as well as by the limitations in collecting and processing such data. Even market segmentation strategies for instance, have typically been based on the *hard credit variables*, *geography* (location), *demographics* (gender, race, age, occupation, income, education, employment status, home ownership, etc.), and a few *psychographic variables* (e.g., values, interests, or lifestyles). The purpose of these strategies have been to reduce credit risk, improve customer acquisition, customer retention, product differentiation, provide customized offerings, design pricing strategies, promotions, etc. While hard credit information has proven very valuable to firms, the recent developments in information and communication technologies have freed us from these traditional constraints. Firms no longer have to rely on just hard information.

With the dramatic improvements in the ability to capture and store vast amounts of detailed soft information about consumers, as well as the availability of tools and techniques to analyze unstructured data, businesses are increasingly becoming aware of the possibilities for leveraging soft information to design more efficient and optimal strategies. In particular, the ability to make sense of soft information about consumer behavior has triggered a paradigm shift, with the move away from purely quantitative strategies to strategies that incorporate both quantitative as well as qualitative factors.

While soft information has been typically hard to gather, analyze, and process, Information technologies today, have led to the "hardening" of soft information. Information contained in blogs, online forums, discussion groups, etc., can be quickly parsed and analyzed to extract valuable information about consumers as well as about firms. Technologies today, even allow valuable information to be extracted from visual and narrative data – information that can be incorporated into existing predictive models to improve their performance. Soft factors such as trust, peer-pressure, and community monitoring, that make social networks and social capital valuable have moved to the forefront with the growth of digital or online social networks. The digitization of these social networks also facilitates the hardening of the soft information contained in these networks, enabling firms as well as consumers to extract value from such information.

CUSTOMER ANALYTICS AND BUSINESS INTELLIGENCE

Information about consumers' choice of products/services or their choice of channels can be used to examine the connections between consumers' underlying characteristics (e.g., risk preferences, price

sensitivities, customer loyalty, etc.) and the products and channels used. Market segmentation models, as well as models of customer attrition, or customer acquisition, and even models of credit risk, can incorporate this information about consumers' choices to improve the efficiency of their predictions.

Solicitation-Based and Channel-Based Segmentation

Firms use a variety of avenues to solicit customers. Direct mail, online solicitations, soliciting customers at airports and other venues, are just some of the plethora of venues firms use to solicit customers for their products. Research suggests that customers not only respond differently to these different solicitation strategies, but there might also be interesting differences among customers who prefer one venue over another. Similarly, firms offer a number of different channels through which customers can access their products and services. Customers typically have a choice of which venue or channel to adopt and tend to select the option that best fits their needs and preferences. For instance, if risk averse customers are less likely to use an online channel, the customers' choices of specific channels and venues provide cues about their underlying characteristics. Understanding not only customer choices, but also how these choices are correlated with underlying characteristics of interest can then help firms develop actionable market segmentation as well as pricing strategies.

Charles, Kerwin Kofi, Erik Hurst, and Melvin Stephens Jr. 2008, Rates for Vehicle Loans: Race and Loan Source, *American Economic Review*, 98:2, 315-320.

EXPERTISE @ DIGITS

Research studies using social network analytics as well as clickstream analytics to understand consumer behaviors in their choice of online brokerages, and financial products, among others, have provided valuable and unique insights beyond those available through traditional business analytics. The role of predictive analytics in financial services is one of the key focus areas for DIGITS. Researchers in DIGITS are also involved in the study of emerging business models such as online social investing and prediction markets and how firms and businesses can leverage these digital innovations for strategic objectives.